

**BOROUGH OF MANHATTAN COMMUNITY COLLEGE**

City University of New York

**Department of Science**

**Title of Course FUNDAMENTALS OF GENERAL ORGANIC &  
BIOLOGICAL CHEMISTRY I**  
**CHE 121 Section \_\_\_\_\_**

**Class hours 3**

**Credits 4**

**Lab hours 3**  
**Instructor Information**  
**Name:**  
**Office Number:**  
**Room Number:**  
**Email Address:**

**Course Description**

This course is the first semester of a two-semester course sequence that introduces principles and concepts of general, organic and biological chemistry.

The laboratory will provide experimental applications of these chemical topics.

*CHE 121-CHE 122 two terms required. Liberal Arts Elective. Recommended for*

*Students intending to transfer to bachelor degree allied health science curricula.*

*CHE 121-CHE 122 cannot be granted credit to fulfill degree requirements for .S. (Science) and for A.S. (Engineering science).*

*CHE 121-CHE122 does not meet science requirement for AA (Liberal Arts).*

**Prerequisites/Co-requisites**

**Student Learning Outcomes**

1. Students will be able to understand the chemistry of living cells.
2. Students will be able to incorporate chemical applications that demonstrate chemistry as a prerequisite to how living organisms work.
3. Students will be able to demonstrate that the diverse topics of chemistry are logical and coherent when considered in the context of principles.
4. Students will be able to describe applications of chemical principles to the life sciences.

**Required Text & Readings**

1. Stoker, H.S., General, Organic and Biochemistry 3<sup>rd</sup>., Houghton Mifflin, 2004
2. Segar, S.L, and Slabaugh, M.R., Laboratory Experiments for General, Organic and Biochemistry, 5<sup>th</sup> Ed., Brooks/Cole

**Other Resources**

**Use of Technology (if applicable)**

**Evaluation & Requirements of Students**

Each semester there will be a minimum of four one-hour examinations, a comprehensive final examination, and fulfillment of laboratory requirement.

Ch/ Sec	Outline of Topics Topic	Pages
<b>Basic Concepts About Matter</b>		
1.1	Chemistry: The Study of Mater	1 – 2
1.2	Physical States of Matter	2 – 3
1.3	Properties of Matter	3 – 4
1.4	Changes in Matter	4 - 5
1.5	Pure Substances and Mixtures	5 - 7
1.6	Elements and Compounds	7 - 8
1.7	Discovery and Abundance of Elements	9 - 11
1.8	Names and Chemical Symbols of the Elements	11 - 12
1.9	Atoms and Molecules	12 - 15
1.10	Chemical Formulas	15 - 15
<b>Measurements in Chemistry</b>		
2.1	Measurement Systems	21 - 22
2.2	Metric System Units	22 - 24
2.3	Exact and Inexact Numbers	25 - 25
2.4	Uncertainty and Measurement and Significant Figures	25 - 27
2.5	Significant Figures and Mathematical Operations	27 - 30
2.6	Scientific Notation	30 - 32
2.7	Conversion Factors and Dimensional Analysis	32 - 36
2.8	Density	37 - 39
2.9	Temperature Scales and Heat Energy	39 - 42
<b>Atomic Structure and Periodic Table</b>		
3.1	Internal Structure of the Atom	47 - 49
3.2	Atomic Number and Mass Number	49 - 50
3.3	Isotopes and Mass Number	50 - 54
3.4	The Periodic Law and the Periodic Table	53 - 55
3.5	Metals and Non Metals	56 - 57
3.6	Electron Arrangements Within Atoms	57 - 61
3.7	Electron Configuration and Orbital Diagrams	61 - 65
3.8	The Electronic Basis for the Periodic Law and the Periodic Table	65 - 68
3.10	Experimental Evidence for the Existence of Subatomic Particles	69 - 71
<b>Chemical Bonding: The Ionic Bond Model</b>		
4.1	Chemical Bonds	77 - 78
4.2	Valence Electrons and Lewis Symbols	78 - 80
4.3	The Octet Rule	81 - 81
4.4	The Ionic Bond Model	81 - 83
4.5	Determination of Ionic Charge, Sign and Magnitude	83 - 85
4.5	Ionic Compound Formation	85 - 86
4.6	Formulas for Ionic Compounds	86 - 87
4.8	The Structure of Ionic Compounds	87 - 89
4.9	Recognizing and Naming Binary Ionic Compounds	89 - 93
4.10	Polyatomic Atoms	93 - 94
4.11	Formulas and Names for Ionic Compounds	95 - 97
<b>Covalent Bonding: The Covalent Bond Model</b>		
5.1	The Covalent Bond Model	101 - 102
5.2	Lewis Structures for Molecular Compounds	102 – 104
5.3	Single, Double, and Triple Covalent Bonds	104 – 105
5.4	Valence Electrons and the Number of Covalent Bonds Formed	105 – 106

5.5	Coordinate Covalent Bonds	106 – 107
5.6	Systematic Procedures for Drawing Lewis Structures	107 – 110
5.7	Bonding in Compounds with Polyatomic Ions Present	110 – 111
5.8	Molecular Geometry	111 – 114
5.9	Electronegativity	114 – 116
5.10	Bond Polarity	116 – 118
5.11	Molecular Polarity	118 – 120
5.12	Naming Binary Molecular Compounds	120 – 122

### **Chemical Calculations: Formula Masses, Moles and Chemical Equations**

6.1	Formula Masses	127 – 128
6.2	The Mole: A Counting Unit for Chemists	128 – 130
6.3	The Mass of a Mole	130 – 132
6.4	Chemical Formulas and the Mole Concept	132 – 133
6.5	The Mole and Chemical Calculations	133 – 136
6.6	Writing and Balancing Chemical Equations	136 – 140
6.7	Chemical Equations and the Mole Concept	140 – 141
6.8	Chemical Calculations Using Chemical Equations	141 – 145

### **Gases, Liquids and Solids**

7.1	The Kinetic Molecular Theory of Matter	149 – 151
7.2	Kinetic Molecular Theory and Physical States	151 – 153
7.3	Gas Law Variables	154 – 154
7.4	Boyles's Law: A Pressure-Volume Relationship	154 – 156
7.5	Charles's Law: A Temperature-Volume Relationship	156 – 157
7.6	The Combined Gas Law	158 – 158
7.7	The Ideal Gas Law	158 – 159
7.8	Dalton's Law of Partial Pressures	159 – 161
7.9	Changes of State	161 – 163
7.10	Evaporation of Liquids	163 – 164
7.11	Vapor Pressure of Liquids	164 – 165
7.12	Boiling and Boiling Point	165 – 166
7.13	Intermolecular Forces of Liquids	166 – 171

### **Solutions**

8.1	Characteristics of Solutions	177 – 178
8.2	Solubility	178 – 180
8.3	Solution Formation	181 – 182
8.4	Solubility Rules	182 – 183
8.5	Solution Concentration Units	183 – 191
8.6	Colloidal Dispersions	191 – 192
8.7	Colligative Properties of Solutions	192 – 193
8.8	Osmosis and Osmotic Pressure	193 – 195
8.9	Osmolality	195 – 198
8.10	Dialysis	198 – 199

### **Chemical Reactions**

9.1	Types of Chemical Reactions	205 – 208
9.2	Redox and Non Redox Reactions	208 – 212
9.3	Terminology Associated with Redox Processes	212 – 213
9.4	Collision Theory and Chemical Reactions	214 – 215
9.5	Exothermic and Endothermic Reactions	215 – 216
9.6	Factors That Influence Reaction Rates	216 – 218
9.7	Chemical Equilibrium	218 – 220
9.8	Equilibrium Constants	220 – 224
9.9	Altering Equilibrium Conditions: Le Chatelier's Principle	224 – 228

### **Acids, Bases, and Salts**

10.1	Arrhenius Acid-Base Theory	234 – 235
10.2	Bronstead-Lowry Acid-Base Theory	235 – 237
10.3	Mono-, Di-, and Triprotic Acids	238 – 238
10.4	Strengths of Acids and Bases	238 – 239
10.5	Ionization Constants for Acids and Bases	239 – 241
10.6	Salts	241 – 241
10.7	Acid-Base Neutralization Reactions	242 – 243
10.8	Self-Ionization of Water	243 – 245
10.9	The pH Concept	245 – 249
10.10	The pKa Method for Expressing Acid Base Strength	249 – 249
10.11	The pH of Aqueous Salt Solutions	249 – 253
10.12	Buffers	253 – 256
10.13	The Henderson-Hasselbalch Equations	256 – 257
10.14	Electrolytes	257 – 259
10.15	Acid-Base Titrations	259 – 261

### **Nuclear Chemistry**

11.1	Stable and Unstable Nuclides	267 – 268
11.2	The Nature of Radioactivity	268 – 269
11.3	Radioactive Decay	269 – 272
11.4	Rate of Radioactive Decay	272 – 274
11.5	Transmutation and Bombardment Reactions	274 – 276
11.6	Radioactive Decay Series	276 – 277
11.7	Chemical Effects of Radiation	278 – 279
11.8	Biochemical Effects of Radiation	279 – 281
11.9	Detection of Radiation	281 – 282
11.10	Sources of Radiation Exposure	282 – 283
11.11	Nuclear Medicine	283 – 286
11.12	Nuclear Fission and Nuclear Fusion	286 – 289
11.13	Nuclear and Chemical Reactions Compared	289 – 289

### **Saturated Hydrocarbons**

12.1	Organic and Inorganic Compounds	294 – 295
12.2	Bonding Characteristics of Carbon Atoms	295 – 295
12.3	Hydrocarbons and Hydrocarbon Derivatives	295 – 296
12.4	Alkanes: Acyclic Saturated Hydrocarbons	296 – 297
12.5	Structural Formulas	297 – 299
12.6	Structural Isomerism	299 – 300
12.7	Conformation of Alkanes	300 – 301
12.8	IUPAC Nomenclature for Alkanes	302 – 306
12.9	Classification of Carbon Atoms	306 – 307
12.10	Branched Chain Alkyl Groups	307 – 307
12.11	Cycloalkanes	308 – 309
12.12	IUPAC Nomenclature for Alkanes	309 – 310
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### **Biomolecules**

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18.8	Classification of Monosaccharides	511 – 514
18.13	Disaccharides	525 – 530
18.14	Polysaccharides	531 – 534
19.1	Structure and Classification of Lipids	546 – 547
19.2	Fatty Acids: Lipid Building Blocks	547 – 551
20.1	Characteristics of Proteins	588 – 588

20.2	Amino Acids: The Building Blocks for Proteins	589 – 591
20.9	Primary Structure of Proteins	601 – 602
22.1	Types of Nucleic Acids	655 – 655
22.2	Nucleotides: Building Blocks of Nucleic Acids	656 – 659
22.3	Primary Nucleic Acid Structure	659 – 662

### Laboratory Syllabus

Experiment	Title
	Laboratory Safety and Laboratory Rules
1.	Measurement and Significant Figures
2.	The Use of the Chemical Balances
3.	The Use of Volumetric Ware and Density
4.	Physical and Chemical Changes
5.	Separations and Analysis
6.	Classification of Chemical Reactions
7.	Analysis Using Decomposition Reactions
8.	Gas Laws
9.	Solution Formation and Characteristics
10.	Reaction Rates and Equilibrium
11.	Acids, Bases, Salts and Buffers
12.	Analysis of Vinegar
13.	Determination $K_a$ for Weak Acids
14.	The Acidic Hydrogens of Acids
15.	Hydrocarbon Structures

#### **College Attendance Policy**

At BMCC, the maximum number of absences is limited to one more hour than the number of hours a class meets in one week. For example, you may be enrolled in a three-hour class. In that class, you would be allowed 4 hours of absence (not 4 days). In the case of excessive absences, the instructor has the option to lower the grade or assign an F or WU grade.

#### **Academic Adjustments for Students with Disabilities**

Students with disabilities who require reasonable accommodations or academic adjustments for this course must contact the Office of Services for Students with Disabilities. BMCC is committed to providing equal access to all programs and curricula to all students.

**BMCC Policy on Plagiarism and Academic Integrity Statement**

Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism.

Students who are unsure how and when to provide documentation are advised to consult with their instructors. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's web side, [www.bmcc.cuny.edu](http://www.bmcc.cuny.edu). For further information on integrity and behavior, please consult the college bulletin (also available online).